

**SECTION 02XXX****HORIZONTAL DIRECTIONAL DRILL****PART 1 GENERAL****1.01 Scope of Work**

The work specified in this section consists of furnishing and installing underground utilities using the horizontal directional drilling (HDD) method of installation for pipes of various sizes, also commonly referred to as directional boring or guided horizontal boring. This work shall include all services, equipment, materials, and labor for the complete and proper installation, testing, restoration of underground utilities and environmental protection and restoration.

**1.02 Contractor Qualifications**

- A. Contractor (or Sub-Contractor) shall provide documented evidence of successful installation of pipe through the horizontal directional drill method for work comparable in nature to the scope of work required by this project for a minimum of two years.
- B. Contractor (or Sub-Contractor) to have successfully self-performed at least (5) horizontal directional drilling projects to install product pipe of a similar nominal diameter and length to the proposed project within the past two years. Owner and Engineer shall have the sole authority to determine the adequacy of the representative projects.
- C. Contractor's (or Sub-Contractor's) project manager, superintendent, drill operator and guidance system operator assigned to horizontal directional drilling shall be experienced in work of this nature and shall have successfully completed projects similar in nature and shall have successfully completed similar projects using horizontal directional drilling. Contractor (or Sub-Contractor) shall submit substantiating evidence of qualifications with the bid submittal documents.
- D. All drilling, drill guidance and pipe joining equipment operators shall be experienced in comparable horizontal directional drilling work, and shall have been fully trained in the use of the proposed equipment by an authorized representative of the equipment manufacturer(s) or their authorized training agents.
- E. All high density polyethylene (HDPE) fusion equipment operators shall be qualified to perform pipe joining using the means, methods and equipment employed by the Contractor. Fusion equipment operators must possess and be able to provide written validation (card or certificate) of current, formal training on all fusion equipment employed on the project, including training and proper use of the

data logging device on the equipment. Training received more than two years prior to operation of the fusion equipment shall not be considered current.

### 1.03 Referenced Standards

- A. American Water Works Association (AWWA) latest edition:
  - 1. AWWA C651 – Disinfecting Water Mains
  - 2. AWWA C901 – Polyethylene Pressure Pipe and Tubing, ½ Inch Through 3 Inch for Water Service
  - 3. AWWA C906 – Polyethylene Pressure Pipe and Fittings, 4 Inch Through 63 Inch for Water Distribution and Transmission
  
- C. American Society of Civil Engineers (ASCE) – Manual of Practice 108 for Pipeline Design for Installation by Directional Drilling
  
- B. American Society for Testing and Materials (ASTM) latest edition:
  - 1. ASTM D638 – Tensile Method for Tensile Properties of Plastics
  - 2. ASTM D790 – Test Materials for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
  - 3. ASTM D2122 – Standard Method of Determining Dimensions of Thermoplastics Pipe and Fittings
  - 4. ASTM D2239 – Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
  - 5. ASTM D2657 – Practice for Heat-Joining of Polyolefin Pipe and Fittings
  - 6. ASTM D2683 – Standard Specification for Socket Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
  - 7. ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping
  - 8. ASTM D2837 – Standard Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
  - 9. ASTM D3035 – Polyethylene (PE) Plastic Pipe (DR-PE) Based on Controlled Outside Diameter
  - 10. ASTM D3261 – Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
  - 11. ASTM D3350 – Polyethylene Plastic Pipe and Fittings Material
  - 12. ASTM F412 – Standard Terminology Relating to Plastic Piping Systems
  - 13. ASTM F714 – Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
  - 14. ASTM F905 – Standard Practice for Qualification of Polyethylene Saddle-Fused Joints
  - 15. ASTM F1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing

16. ASTM F1056 – Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings
  17. ASTM F1290 – Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings
  18. ASTM F1962-11 – Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings
  19. ASTM F2164 – Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
  20. ASTM F2206 – Fabricated Fittings for Butt-Fused Polyethylene Plastic Pipe
  21. ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
  22. ASTM F2786 – Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Gaseous Testing Media Under Pressure (Pneumatic Leak Testing)
  23. ASTM F3124 – Standard Practice for Data Recording the Procedure used to Produce Heat Butt Fusion Joints
  24. ASTM F3190 – Standard Practice for Heat Fusion Equipment (HFE) Operator Qualifications on Polyethylene (PE) and Polyamide (PA) Pipe and Fittings
- D. North American Society for Trenchless Technology (NASTT) latest edition:
1. NASTT’s Horizontal Direction Drilling (HDD) Good Practices Guidelines – 4th Edition
- E. Plastics Pipe Institute (PPI) latest edition:
1. The Plastics Pipe Institute Handbook of Polyethylene Pipe – Chapter 12 Horizontal Directional Drilling
  2. PPI – TN-36 – General Guidelines for Connecting HDPE Potable Water Pressure Pipes to DI and PVC Piping Systems
  3. PPI – TN-38 – Bolt Torque for Polyethylene Flanged Joints
  4. PPI – TN-44 – Long Term Resistance of AWWA C906 Polyethylene (PE) Pipe to Potable Water Disinfectants
  5. PPI – TN-45 – Mechanical Couplings for Joining Polyethylene Pipe
  6. PPI – TN-46 – Guidance for Field Hydrostatic Testing of High Density Polyethylene Pressure Pipelines: Owner’s Considerations, Planning, Procedures, and Checklists
  7. PPI – TN-49 – Recommendations for AWWA C901 Service Tubes in Potable Water Applications
  8. PPI – TN-54 – General Guidelines for Squeezing Off Polyethylene Pipe in Water, Oil and Gas Applications
  9. PPI – TR-46 – Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High Density Polyethylene Pipe

- F. Plastics Pipe Institute Municipal Advisory Board (MAB)
  - 1. MAB Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene (PE) Pipe
  - 2. MAB Generic Electrofusion Procedure for Field Joining of 14 Inch to 30 Inch Polyethylene (PE) Pipe
  - 3. MAB Model Specifications for PE 4710 Buried Potable Water Service, Distribution and Transmission Pipes and Fittings

#### 1.04 Submittals

- A. Contractor shall submit personnel information detailing the names and resumes, including specific project experience, for the proposed project manager, superintendent, guidance operator and drill operator proving that the experience meets the requirements detailed in this specification.
- B. Contractor shall submit personnel information, including specific project experience, for all proposed drilling, drill guidance, and pipe joining equipment operators, including evidence of training in the use of the proposed equipment by an authorized representative of the equipment manufacturer or their qualified agent.
- C. Provide technical data for the equipment to be used on the project, including make, model and technical specifications for each of the following:
  - 1. Horizontal directional drill rig
  - 2. Drilling system components
  - 3. Downhole drilling assembly and reaming equipment
  - 4. Downhole pressure sub
  - 5. Guidance and control system
  - 6. Pulling head
  - 7. Swivels
  - 8. Rollers
  - 9. Solids separation and drill fluid recirculation systems
  - 10. Pipe fusion equipment
  - 11. Pipe fusion data logger
  - 12. Pipe handling equipment
  - 13. Pigs and pigging equipment
  - 14. Calibration certification for the pilot bore guidance and control system
  - 15. Calibration certification for the heat fusion datalogger
- D. Submit pipe catalog information confirming that pipe, fittings, joints, and other materials conform to the requirements of the specifications.
- E. Submit pipe manufacturer's most current calculations regarding tensile load limitations for trenchless installations.

- F. Provide information showing staging and pipe fusion areas, site access during work activities, pipe storage and handling and procedure for pipe joining.
- G. Submit a proposed bore path layout in both plan and profile. The proposed bore path shall conform to the drilling equipment and pipe material constraints.
- H. Provide a work plan detailing the procedure and schedule to be used to execute the project. Horizontal directional drilling shall not commence until the contractor has received written approval of all work plan submittals. The Contractor shall provide complete descriptions of proposed plans, procedures and personnel, as well as supporting calculations for the following:
  - 1. Drilling operations, addressing procedures for pilot hole drilling and reaming, tracking and controlling the drilling head locations and the preparation of as-built documentation
  - 2. Drilling fluid management
  - 3. Spoils handling and disposal
  - 4. Pipe pullback and pullback monitoring.
  - 5. Prevention of inadvertent fluid losses and spills, including contingencies for rapid containment and cleanup, including procedures for monitoring and controlling drilling fluid flows and pressures, equipment, resources and procedures for identifying, containing and cleaning up fluid losses and spills
  - 6. Quality control and testing procedures
  - 7. Safety plan
- I. Provide a supplemental work plan in advance of performing the horizontal directional drill work. Horizontal directional drilling shall not commence until the contractor has received written approval of all supplemental work plan submittals. The work plan shall specifically address the following potential problems:
  - 1. Obstructions along bore path during reaming or pull back
  - 2. Drill pipe or product pipe cannot be advanced
  - 3. Deviations from design line and grade exceed allowable tolerances
  - 4. Drill pipe or product pipe broken off in borehole
  - 5. Collapse of product pipe or excessive deformation
  - 6. Damage to existing utilities
  - 7. Excessive subsidence or heave
- J. Design Requirements
  - 1. Horizontal alignment shall be as shown on the project documents. The maximum depth shall be determined based on a minimum clearance from existing or proposed utilities to be crossed or the minimum clearances shown on the Drawings, whichever is greater. Bending radius shall not be less than the manufacturer's recommended minimum bending radius of the pipe. Compound curvatures may be used, but shall not exceed the

maximum deflections as set forth by the manufacturer or AWWA standards, whichever is more strict.

2. In accordance with ASTM F1962-11, Bore Entry (Pipe exit) angle shall be between 8 and 20 degrees and Bore Exit (Pipe Entry) angle shall be relatively shallow, preferably less than 10 degrees. Any deviation from these angles should be submitted to the Owner for approval.
- K. Provide detailed design calculations in accordance with ASTM F1962. The calculations shall support the Contractor's specific proposed means, methods and products. The Contractor's final design calculations shall be prepared and sealed by a Licensed Professional Engineer registered in the State as to which the Project is located. Horizontal directional drilling shall not commence until the contractor has received written approval of all design calculation submittals. Design calculations shall demonstrate that the proposed pipe, equipment and means and methods comply with the requirements of this specification and have been designed based on the design borepath, installation means and methods, for anticipated installation and handling, hydrostatic, earth and live loads, installation temperature and site conditions. Contractor shall provide the following calculations:
1. Maximum allowable pipe loading limits
  2. Design radius of the proposed bore path, including minimum radii for all curves
  3. Pullback load calculation based on proposed drill path plan and profile including pipe stress calculations
  4. Confirmation that the design parameters do not result in installation stress that exceeds allowable pipe stresses
  5. Bouyancy effect calculations (if applicable)
  6. Effects of ballasting plan on pipe pullback forces (if applicable)
  7. Hydrofracture analysis
- L. Contractor shall provide a plan to locate and protect all adjacent utilities and infrastructure.
- M. Submit traffic control plan for all entrance and exit pits.
- N. Submit bore logs that clearly indicate the pipe diameter, location (by station), and depth below grade of the installed pipeline, recorded every 10 feet maximum along the pipeline. Submit within 7 days of the completion of each bore.
- O. Provide as-built documentation. Contractor shall plot as-built conditions on the field drawings, including the location in plan and elevation of the drill string, reaming head, and installed pipe, at the completion of each production shift. Include on the drawings pipeline horizontal and vertical data recorded every 10 feet along the pipeline or once per joint of drill pipe.

- P. Contractor to maintain all testing and quality control documentation and assurance procedures. Contractor to provide the following documents to the Owner:
  - 1. Quality control test reports
  - 2. Fusion reports for each weld as reported by the datalogger

### **1.05 Utility Locating**

- A. The Contractor shall be responsible for following the procedures in this specification to identify, locate and verify the presence of existing utilities along the route of the proposed pipeline or work areas.
- B. Utility locating will be performed in three parts: identification, designating and verification.
  - 1. Utility Identification – Identify the presence of underground utilities through Florida One Call service and visual observation of surface markers or other indicators such as manholes, valve boxes, fire hydrants, etc.
  - 2. Utility Designation – Marking the location of underground utilities with paint or flags based on utility owner information or third party locating equipment.
  - 3. Utility Verification – Verification of Utility Identification and Designation by excavation or other methods to determine the horizontal and vertical location of the underground utility. This also provides the size and material of the underground utility. Approved methods to accomplish this task include vacuum excavation, potholing, and test holes with traditional equipment (backhoes, etc.)
- C. The Contractor shall record the location (horizontal and vertical) of all known utilities, as defined within this specification, on the project documents. At a minimum, utilities shall be located by station and offset from the project baseline or with state plan coordinates. Vertical location can be based on depth from existing grade or elevation using the project vertical datum.
- D. The project documents showing all known existing utilities shall be submitted to the Owner's Representative for review and to document, prior to construction, the known utilities within the project limits. The Owner's Representative will have a five (5) working day period to review and approve or comment on the utility locations.
- E. The approved project documents showing the existing utilities shall be the basis for changes to the contract as addressed within these specifications.
- F. Utilities located and documented as described above then subsequently damaged by the Contractor under this contract will have no basis for claims against the Owner for costs associated with repairs, delays, etc.

- G. Damage to existing underground utilities that were not identified by the procedures noted above will be the utility owner's responsibility to repair or replace.

## **PART 2 PRODUCTS**

### **2.01 Polyethylene Pipe, Fittings and Accessories**

- A. Polyethylene pipe and fittings 4-30 inch diameter shall be in accordance with AWWA C906, material designation code of PE4710 and all applicable ASTM standards.
- B. Polyethylene pipe ½ -3 inch diameter for main line piping shall be polyethylene pipe (not tubing) in accordance with AWWA C901, material designation code of PE4710 and all applicable ASTM standards.
- C. Butt fusion fittings shall be made of HDPE material with a minimum material designation code of PE4710 and all applicable ASTM standards. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified on the project documents. All fittings shall meet the requirements of AWWA C901, C906 and all applicable ASTM standards. Markings for molded fittings shall comply with the requirements of ASTM D3261. Fabricated fitting shall be marked in accordance with ASTM F2206. Socket fittings shall meet ASTM D2683. Fabricated fittings shall be manufactured using a McElroy DataLogger to record fusion time, pressure and temperature, and shall be marked with a unique joint identifier that corresponds to the joint report. A graphic representation of the time and pressure data for all fusion joints made producing fittings shall be maintained for a minimum of five years as part of quality control and will be available upon request of owner. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past two years on the equipment to be utilized on this project in accordance with ASTM F2620.
- D. Electrofusion fittings shall be made of HDPE material with a minimum material designation code of PE4710 and meet ASTM F1055. Electrofusion fittings shall have a pressure rating equal to the pipe unless otherwise specified on the project documents. All electrofusion fittings shall be suitable for use as pressure conduits and have nominal burst values of four times the working pressure rating of the fitting. Marking of electrofusion fittings shall comply with the requirements of ASTM F1055. All electrofusion fittings shall be properly stored in compliance with the manufacturers recommendation.
- E. Saddle fusion could be used to fuse branch saddles, tapping tees and other HDPE fittings onto the wall of the main pipe. Saddle fusion shall be done in accordance with ASTM F2620 or PPI TR-41 or the fitting manufacturer's recommendations. Saddle fusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within



the past two years on the equipment to be utilized on this project in accordance with ASTM F3190.

- F. Socket fusion could be used to fuse branch saddles, tapping tees and other HDPE fittings onto the wall of the main pipe. Socket fusion shall be done in accordance with ASTM D2683 or the fitting manufacturer's recommendations. Socket fusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past two years on the equipment to be utilized on this project in accordance with ASTM F3190. All equipment used for socket fusion should comply with ASTM F1056 and manufacturer's recommendations.
- G. Flanges and Mechanical Joint Adapters (MJ) shall have a minimum material designation code of PE4710 and meet all applicable AWWA and ASTM standards. Flanged and MJ adapters can be made to ASTM D3261 or machined in compliance with ASTM F2206. Flanges and MJ adapters shall have a pressure rating equal to the pipe unless otherwise specified on the project documents. Markings for molded or machined flange adapters or MJ adapters shall be per ASTM D3261. Fabricated (including machined) flange adapters shall be marked per ASTM F2206. Installation of all Flanged adapters shall follow the guidelines of the Plastics Pipe Institute TN-38.
- H. Glands, bolts, and gaskets shall be manufactured in accordance with AWWA C153. Bolts and nuts shall be grade 2 or higher.

## **2.02 Pipeline Identification**

- A. All polyethylene pipe shall be marked in accordance with the standards to which it is manufactured.
- B. All polyethylene pipe shall be black, and shall contain a continuous colored stripe, 2 inches wide, located at no greater than 90 degree intervals around the pipe. Stripes shall be impregnated or molded into the pipe by the manufacturer. Application of the stripes after manufacture is not acceptable. Stripe color shall be:
  - 1. Potable Water Mains - blue stripes
  - 2. Reclaimed Water Mains - purple stripes
  - 3. Force Mains - brown stripes
  - 4. Sanitary Sewer - green stripes
  - 5. Storm Sewer - no stripes required

## **2.03 Tracer Wire**

- A. Installation of Tracer Wire. The Contractor shall be required to install tracer wire during the horizontal directional drilling operations including along all pits for connections. The tracer wire shall be installed simultaneously with the PE piping

system. Tracer wire shall be properly spliced at each end connection and each service connection. Care should be taken to adequately wrap and protect wire at all splice locations. No bare tracer wire shall be accepted. Provide Magnesium alloy anode for cathodic protection that conforms to the requirements of ASTM B843. Install tracer wire per local and manufacturer's requirements. A minimum of three separate tracer wires shall be installed with the Directional Bore. Contractor shall be required to provide as many wires as necessary to maintain continuity throughout the length of the directional bore. Failure of continuous continuity in the locating wire shall result in abandonment and reinstallation of the directional drill, at the discretion of the Owner.

1. Tracer wire shall be three (3) 3/16-inch, 7 x 7 (or stronger) Stranded Copper Clad Steel Extreme Strength with 4,700 lb. break load, or braided stainless steel (A304 or A316), with minimum 50 mil HDPE insulation thickness.

#### **2.04 Drilling Fluids**

- A. All drilling fluids should be a bentonite slurry mixture with any applicable amendments as determined by the drill operators.

#### **2.05 Delivery, Storage and Handling of Materials**

- A. Contractor is required to inspect materials delivered to the site for damage. All materials found during inspection or during the progress of work to have cracks, flaws, or other defects shall be rejected and removed from the job site without delay.
- B. Contractor is responsible for obtaining, transporting and sorting any fluids, including water, to the work site.
- C. Contractor is responsible for disposal of fluids on the project site. The disposal of fluids shall be done in compliance with all permits and applicable federal, state or local environmental regulations. The bentonite drilling slurry may be recycled for reuse in the hole opening operation, or shall be hauled by the Contractor to an approved location or landfill for proper disposal. Contractor shall thoroughly clean the project area or any fluid residue upon completion of installation and replace any and all plants and sod damaged, discolored or stained by drilling fluids.

### **PART 3 EQUIPMENT**

#### **3.01 General**

- A. The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the drill, a drilling fluid recycling system to remove solids from the drilling fluid so

that the fluid can be re-used, a guidance system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of the project.

### 3.02 Drilling System

- A. Drilling Rig – the directional drilling machine shall consist of a power system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The power system shall be self contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations. The rig shall be grounded during drilling and pull-back operations. There shall be a system to detect electrical current from the drilling string and an audible alarm which automatically sounds when an electrical current is detected.
- B. Drill Head – the drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.

### 3.03 Guidance System

The guidance system used shall provide real time electronic data to the inspector on request. All daily data and project data shall be displayed on the As-built documentation. The guidance system shall be capable of tracking a depth of 40 feet or 20 feet below design bore path, whichever is greater, and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction,) and inclination (vertical direction.) The guidance system shall be accurate to +/- 2% of the vertical depth of the borehole at sensing position at depths up to one hundred feet and accurate within 2 feet horizontally.

The Guidance System shall be of a proven type and shall be operated by personnel trained and experienced with this system. The equipment operator shall be aware of any magnetic anomalies on the surface of the drill path and shall consider such influences in the operation of the guidance system if using a magnetic system.

- A. Bore Tracking and Monitoring – at all times during the pilot bore, the Contractor shall provide and maintain a bore tracking system that is capable of accurately locating the position of the drill head in the x, y, and z axes. The Contractor shall record these data at least once per drill pipe length or every twenty-five (25) feet, whichever is more frequent.

- B. Downhole and Surface Grid Tracking System – the Contractor shall monitor and record x, y, and z coordinates relative to an established surface survey bench mark. The data shall be continuously monitored and recorded at least once per drill pipe length or at twenty-five (25) feet, whichever is more frequent.
- C. Deviations between the recorded and design bore path shall be calculated and reported on the daily log. If the deviations exceed the allowable tolerances from the design path, such occurrences shall be reported to the Owner. The Contractor shall undertake all necessary measures to correct deviations and return to design line and grade.
- D. Drilling Fluid Pressures and Flow Rates – Drilling fluid pressures and flow rates shall be continuously monitored and recorded by the Contractor. The pressures shall be monitored at the pump. These measurements shall be made during pilot bore drilling, reaming and pullback operations.

### **3.04 Drilling Fluid (Mud) System**

- A. Mixing System – a self contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid. Mixing system shall continually agitate the drilling fluid during operations.
- B. Drilling Fluids – drilling fluid shall be composed of clean water, appropriate additives and clay. Water for mixing the drilling fluid shall be potable water, procured by the Contractor. The water and additives shall be mixed thoroughly and be absent of any clumps or clods. Vary the fluid viscosity to best fit the soil conditions encountered. Do not use any other chemicals or polymer surfactants in the drilling fluid without written consent from the Engineer. Certify to the Engineer in writing that any chemicals to be added are environmentally safe and not harmful or corrosive to the facility.
- C. Delivery System – the delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe shall be relatively leak-free. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and conveyed to the drilling fluid recycling system. A berm, minimum of 12” high, shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid cycling systems to prevent spills into the surrounding environment. Pumps and or vacuum truck(s) of sufficient size shall be in place to convey excess drilling fluid from containment areas to storage and recycling facilities.
- D. Drilling Fluid Viscosity – in the event that inadvertent returns or returns loss of drilling fluid occurs during pilot hole drilling operations, the Contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with an appropriate viscosity and then wait another 30 minutes. If mud fracture or returns loss continues, the Contractor shall cease operations and notify the Owner.

- E. Drilling Fluid Recycling System – the drilling fluid recycling system shall separate sand, dirt and other solids from the drilling fluid to render the drilling fluid re-usable. Spoils are separated from the drilling fluid will be stockpiled for later use or disposed.
  
- F. Control of Drilling Fluids – the Contractor shall follow all requirements of the proposed work plan and supplemental work plan as submitted and approved and shall control operations pressures, drilling mud weights, drilling speeds and any other operational factors to avoid hydrofracture fluid losses to formations, and control drilling fluid spillage. This includes any spillages or returns at entry and exit pit locations or at any intermediate point. All inadvertent returns or spills shall be promptly contained and cleaned up. The Contractor shall maintain on-site mobile spoil removal equipment during all drilling, pre-reaming and pullback operations and shall be capable of quickly removing spoils. The Contractor shall immediately notify the Owner of any inadvertent returns or spills and immediately contain and clean up the return or spill.

### **3.05 Other Equipment**

- A. Pipe Rollers – pipe rollers, if used, shall be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull back operations. Sufficient number of rollers shall be used to prevent excess sagging of pipe.

### **3.06 Data Logger**

- A. A data logger shall be used to record and document all butt fusion process. The data logger must be compatible and outfitted with an electronic data recording device. A digital report or printout for all fusion joints made that complies with, but is not limited to, ASTM F3124 must be delivered to the OWNER upon request and at the completion of the project. All hydraulic fusion must be recorded and able to produce a graphic representation of the time and pressure data. All manual fusion must be recorded with, but not limited to, Joint ID, Operator Name and ID, Pipe information, and Heater Plate Temperature. The recording unit shall be a DataLogger 6 as manufactured by McElroy Manufacturing, Inc, or newer model or approved equivalent.

## **PART 4 EXECUTION**

### **4.01 General**

- A. Locate positions of entry and exit pits, establish elevation and horizontal datum for bore head control, and lay out pipe assembly area. Lay out and assemble pipe in a manner that does not obstruct adjacent roads, and commercial or residential activities adjacent to construction areas.

- B. Proposed deviations from the bore path due to underground obstructions shall be approved by the Engineer prior to construction.
- C. Horizontal and vertical tolerance of the installed bore path from approved bore path shall be within  $\pm 6$  inches in the vertical plane and within  $\pm 2$  feet in the horizontal plane.
- D. The maximum allowable pull load determined during the design calculations for the installed Polyethylene pipe system should not be exceeded. If the maximum observed pull load exceeds the maximum allowable pull load, the Owner may request the drill be re-installed with new Polyethylene pipe at the Contractor's expense.
- E. Final acceptance including final payment of directional bored pipelines will not be made until directional bore logs have been submitted and the information on the bore logs documents the depth of the installed pipeline is in accordance with these specifications.

#### 4.02 Directional Drilling

- A. The installation of pipeline by directional drilling shall be within the limits indicated on the drawings, unless otherwise approved by the Owner or Engineer.
- B. Install erosion control measures and dewater as required.
- C. Steering of the bore must be performed with a method approved by the boring equipment manufacturer. Such methods include walkover, wire line, wire line with surface grid and other accepted methods. Use a locating and tracking system capable of ensuring that the proposed installation is installed as intended. The locating and tracking system must provide information on:
  - 1. Clock and pitch information
  - 2. Depth
  - 3. Transmitter temperature
  - 4. Battery status
  - 5. Position (x,y)
  - 6. Azimuth, where direct overhead readings (walkover) are not possible (i.e. subaqueous or limited access transportation facility)
- D. Ensure proper calibration of all equipment before commencing drilling operation. Take and record alignment readings or plot points such that elevations on top of and offset dimensions from the center of the product to a permanent fixed feature are provided. Such permanent fixed feature must have prior approval of the Owner or Engineer. Provide elevations and dimensions at all bore alignment corrections (vertical and horizontal) with a minimum distance between points of 20 feet.

Provide a sufficient number of elevations and offset distances to accurately plot the vertical and horizontal alignment of the installed product. A minimum of three elevation and plot points are required.

- E. The depth of the directional drilling shall be the minimum necessary to prevent surface heave, unless the drawings require the installation to be at deeper depths. Any proposed changes to the depth of the directional bore from what is shown on the drawings must be approved by the Engineer in writing, prior to commencement of drilling. Where utilities cross under department of transportation (DOT) roads, the depth of cover shall comply with any applicable DOT permits.
- F. Borings shall be conducted using a mechanical boring head, assisted by and cooled by drilling fluid of low pressure and volume. Material Safety Data Sheets must be provided and approved by the Engineer for all drilling slurry compounds.
- G. Back reaming shall be conducted to enlarge and prepare the bore hole for pipe installation. Minimize potential damage from soil displacement or settlement by limiting the ratio of the bore hole to the product size. The size of the back reamer bit or pilot bit, if no back reaming is required, shall be limited relative to the product diameter.
- H. Ensure adequate removal of soil cuttings and stability of the bore hole by monitoring the drilling fluids such as the pumping rate, pressures, viscosity and density during the pilot bore, back reaming and pipe installation. Obtain the Engineer's approval of the location and all conditions necessary to construct relief holes to relieve excess pressure and ensure the proper disposition of drilling fluids is maintained.
- I. Minimize heaving during pull back. The pull back rate used shall maximize the removal of soil cuttings without building excess down hole pressure. Contain excess drilling fluids at entry and exit points until they are recycled or removed from the site or vacuumed during drilling operations. Entry and exit pits are to be of sufficient size to contain the expected return of drilling fluids and soil cuttings.
- J. Ensure that all drilling fluids are disposed of or recycled in a manner acceptable to the appropriate local, state, or federal regulatory agencies. If in the drilling process it becomes evident that the soil is contaminated, contact the Engineer immediately. Do not continue drilling without the Engineer's approval.
- K. Install the carrier in the bore hole within the same day that the pre-bore is completed to ensure stability.

#### **4.03 Pipe Joining**

- A. High density polyethylene pipe shall be heat fused and pressure tested as per manufacturer's guidelines before installation in the bore hole. During assembly and

prior to pullback, pipe must be laid out in such a way as to minimize interference to pedestrian and vehicular traffic.

- B. Cuts or gouges that reduce the wall thickness by more than 10% are not acceptable and must be cut out, discarded and the pipe rejoined.
- C. Each butt fusion shall be recorded and logged by a datalogger affixed to the fusion machine. Joint data shall be submitted as part of the As-built documentation.
- D. Mechanical joining – Polyethylene pipe and fittings may be joined together or to other materials by means of flanged connections or mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another pipe material. Mechanical couplings shall be fully pressure rated and fully thrust restrained and installed in accordance with manufacturer’s recommendations.
- E. Install required locator wire along polyethylene pipe prior to pulling through bore hole as per these specifications.
- F. After pulling pipe, clean exposed ends for installation of fittings, test locator wire for continuity.

#### **4.04 Boring Failure**

- A. If an obstruction is encountered during boring which prevents completion of the installation in accordance with the drawings and specifications, either remove the pipe or abandon the pipe in place at the discretion of the Engineer.
- B. If the pipe cannot be withdrawn and Engineer approves abandoning the pipe in place, cut pipe off at least 3 feet below ground surface, fill annular space and pipe with excavatable flowable fill and cap ends of pipe with blind flange.
- C. In the event of failure to install pipe, retain possession of pipe and remove it from the site.
- D. Upon approval of the Engineer, fill the abandoned bore hole with excavatable flowable fill.
- E. Submit a new installation procedure and revised plans to the Engineer for approval before resuming work at another location.
- F. If, during construction, damage is observed to the facility, cease all work until resolution to minimize further damage and a plan of action for restoration is obtained and approved by the Engineer.
- G. If the submitted boring logs indicate the installed alignment does not meet vertical or horizontal alignment requirements, the boring is considered a failure, and the



directional bored pipeline shall be either re-bored or otherwise remedied at the discretion of the Owner.

#### **4.05 Swabbing**

- A. The purpose of swabbing a new pipeline is to conserve water while thoroughly cleaning the pipeline of all foreign material, sand, gravel, construction debris and other items not found in a properly cleaned system. Prior to pressure testing of a new pipeline swabbing shall be utilized as specified on the project documents for each project.
- B. New water, sewer force and reclaimed mains greater than 12” ID (unless determined otherwise by the Owner) shall be hydraulically cleaned with a polypropylene swabbing device to remove dirt, sand and debris from main.
- C. If swabbing access and egress points are not provided in the design drawings, it will be the responsibility of the Contractor to provide temporary access and egress points for the cleaning, as required.
- D. Cleaning of the system shall be done in conjunction with, and prior to, the initial filling of the system for its hydrostatic test.
- E. The line to be cleaned shall only be connected to the existing distribution system at a single connection point.
- F. At the receiver or exit point for the poly swab, the Contractor is responsible for creating a safe environment for collection of debris, water and the swab. Considerations shall be made for protecting surrounding personnel and property and safe retrieval of the swab.

#### **4.06 Testing**

- A. Disinfection tests
  - 1. All water pipe and fittings shall be thoroughly disinfected prior to being placed in service. Disinfection shall follow the applicable provisions of the procedure established for the disinfection of water mains as set forth in AWWA C651. Bacteriological testing on the water main shall be scheduled, completed and sent for water analysis (lab testing.) The results of the lab testing shall be sent to the Owner. No pipeline shall be placed into service until it is properly disinfected and water analysis proves it is disinfected.
  - 2. Temporary blow-offs shall be installed for the purpose of cleaning the water main. Temporary blow-offs shall be removed and plugged after the main is cleared. The main shall be flushed prior to disinfection.

3. The new water main shall be connected to the existing water main at one point only for flushing purposes. The new main **MUST** have a blow off on the end as required. After the new main is thoroughly flushed, the open end shall be sealed and restrained and the main shall be thoroughly disinfected.

**B. Pressure and Leakage tests**

1. Conduct hydrostatic pressure testing of installed polyethylene pipe in accordance with ASTM F2164.
2. For HDPE mains, fill the main slowly ensuring fill rate does not exceed capacity of air release devices. Once air has been expelled from the system, gradually raise the pressure to 160 psi. Add makeup water as necessary to maintain this pressure as necessary for 4 hours. After the 4 hour period, reduce main pressure to the 150 psi test pressure and monitor for 1 hour. Do not increase pressure or add makeup water during this one hour period. The test is passed and considered acceptable if the main pressure does not drop more than 5% (7.5 psi) during the one hour period.
3. If any defects or leaks are revealed, they should be corrected and the pipeline retested after a minimum 24 hour recuperation period between tests. Total testing conducted on a section of pipeline shall not exceed 8 hours within a 24 hour period.

**4.07 Disposal of Surplus Fluids**

- A. All drill fluid excess shall be contained in entry and/or exit pits and pumped as needed into additional on-site storage tanks, tanker trucks, vacuum trucks, etc. Dispose of excess drill fluid offsite as allowed by local rules and regulations.
- B. Dispose of all material not needed or not suitable for backfilling over or around the entry and receiving pits. The disposal shall be subject to local codes and regulations.

**4.08 Restoration**

After extraction, drill fluids, pits, work areas, staging and storage areas are to be restored to equal or better condition than pre-construction condition.

**END OF SECTION**